PAYLOAD FLIGHT HAZARD REPORT				a. NO:	AMS-02-F12
b. PAYLOAD	Alpha Magnetic Spectrometer-02 (AMS-02)			c. PHASE:	II
d. SUBSYSTEM:	Electrical, Integration	e. HAZARD GROUP:	Injury/Illness, Damage to Hardware	f. DATE:	March 31, 2006
g. HAZARD TITLE:	Mate/Demate of Connectors			i. HAZARD CATEGORY:	CATASTROPHIC **X** CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS:	NSTS 1700.7B, ISS Addendum: 200.1, 200.1b				
j. DESCRIPTION OF HAZARD:	The mating/demating of connectors associated with the exterior elements of the AMS-02 can result in the damage to integration hardware, payload hardware, the generation of molten debris and loss of system capabilities. Electrical shock is not considered a hazard due to insulating properties of the EMU (Per NSTS/ISS 18798, MA2-99-170 explanatory text). The following are the connectors that will be mated/disconnected during the course of the AMS-02 Mission. ROEU, UMA, PVGF, AMS-02 EVA Connector.				
k. CAUSES *(list)*	1. Mate/Demate with power in connection. 2. Connector mismate. 3. Bent pin shorting				

o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I		
PHASE II		
PHASE III		

PAYLOAD FLIGHT HAZARD REPORT		a. NO:	AMS-02-F12
b. PAYLOAD	Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE:	II
l. HAZARD CONTROL (CONTROL), m. SAFETY VERIFICATION METHODS (SVM), n. STATUS OF VERIFICATIONS (STATUS)			OPS CONTROL
1. CAUSE: Mate/Demate with power in connection.			
1.1 CONTROL: A contingency EVA operation is provided for in the AMS-02 design to be able to switch the routing of power to the AMS-02 to swap the internal AMS-02 buses between the two ISS supplies. As only one AMS-02 bus is capable of charging the AMS-02 Cryogenic Magnet, it is essential to retain this capability. To accomplish this EVA task and provide the required two upstream inhibits to preclude arcing/sparking during connector demate/mate power provided by Utility Rail S3 2B3A 3A (DDCU P1-3A) and Utility Rail S3 1A4B 4B (DDCU S1-4B) must be inhibited. Each of these power sources are routed through RPCMs to control power to the individual PAS locations. The power will be switched (on/off) at RPCM S3-3A-E(A2) and RPCM S3-4B-E (A9) (respective) to inhibit power availability to the AMS-02. The second inhibit will involve the remote retraction of the UMA connection to provide physical isolation of the AMS-02 from the ISS power sources. AMS-02 does not have the means of removing or limiting downstream loads to meet the low power option of MA2-98-170. 1.1.1 SVM: Review of Procedures to assure that operational steps to remove power are in place. 1.1.1 STATUS: OPEN			I
NOTE: Remote operation of program provided connectors (ROEU, SSRMS, UMA) will be controlled by the nominal operating procedures of the vehicles supporting the remote operations. Generically this involves isolating the power and then operating the remote connection. No EVA crew are involved with this nominal operation. In the event of remotely operated connectors failing either to mate or demate, EVA capability has been designed into the remotely operated devices to fulfill the automated operation. AMS-02 does not have the capability to reduce loads or eliminate the consumption of power to meet the low power option of MA2-98-170, thus the vehicle must provide additional inhibits to power to satisfy the requirements for EVA mate/demate of connectors for any contingency procedure where EVA operations on the automated connectors are performed.			
1.2 CONTROL: AMS-02 EVA Accessible connectors are an EVA compatible design, are of a scoop proof design and keyed to require a specific orientation for connection. The EVA connection has the “hot” side terminated in sockets and not pins. The EVA connectors used are compliant with NASA SSQ-21635, “General Specification For Connectors And Accessories, Electrical, Circular, Miniature, IVA/EVA Compatible, Space Quality”. 1.2.1 SVM: Review of design			

PAYLOAD FLIGHT HAZARD REPORT		a. NO:	AMS-02-F12
b. PAYLOAD	Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE:	II

1.2.2 SVM: Inspection of as built hardware 1.2.1 STATUS: Open 1.2.2 STATUS: Open	
1.3 CONTROL: AMS-02 EVA Connectors fully enclose the interconnecting pins and sockets prior to engagement. Engagement of the pins and sockets is externally controlled by use of EVA operated lever. 1.3.1 SVM: Review of design 1.3.2 SVM: Inspection of as built hardware 1.3.1 STATUS: Open 1.3.2 STATUS: Open	
1.4 CONTROL: The AMS-02 Uninterruptible Power Supply (UPS) can not supply power to any EVA connector or vehicle power interface. 1.4.1 SVM: Testing of flight power interfaces for UPS power. (Tested at the UMA Interface) 1.4.1 STATUS: Open	
1.5 CONTROL: In the event of the situation where the SSRMS has delivered the AMS-02 to the PAS location and the UMA is connected, power from the UMA will be switched off and a diode protection included in the AMS-02 circuitry will prevent power, originating from the UMA, from being present in the PVGF. Control of SSRMS power supply through the arm is a standard GFE procedure as indicated in preceding NOTE. 1.5.1 SVM: Review of Design 1.5.2 SVM: Testing of PVGF blocking diodes. 1.5.1 STATUS: Open 1.5.2 STATUS: Open	
2. CAUSE: Connector Mismate.	
2.1 CONTROL: EVA connectors are keyed to only connect to compatible locations and in appropriate orientation. Each connector application uses different connectors with differing housing diameters and internal pin configurations. Attachment to hazard report provides technical detail of each connector application.	

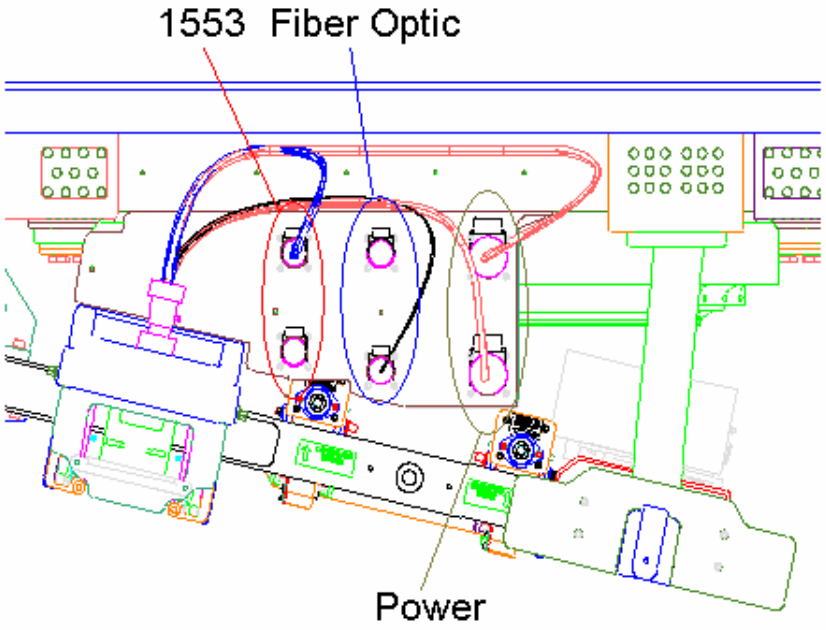
PAYLOAD FLIGHT HAZARD REPORT		a. NO:	AMS-02-F12
b. PAYLOAD	Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE:	II

2.1.1 SVM: Review of design 2.1.2 SVM: Inspection of as built hardware 2.1.1 STATUS: Open 2.1.2 STATUS: Open	
3. CAUSE: Bent Pin Shorting	
3.1 CONTROL: The pin assignments within the AMS-02 EVA connectors will be assigned such that a bent pin will not short power to return. 3.1.1 SVM: Bent Pin Analysis. 3.1.1 STATUS: Open	
3.2 CONTROL: Any potential contact between pins/bent pins will only occur when connector shells have already mated, containing any products of arcing/shorting. 3.2.1 SVM: Review of connector design. 3.2.1 STATUS: Open	
Notes:	

ACRONYMS	
ACASS – Active Common Attach Site Simulator	PtP – Peak to Peak
AKA – Active Keel Assembly	PVGF – Power Video Grapple Fixture
AMS-02 – Alphamagnetic Spectrometer - 02	QTY – Quantity
APS – Automated Payload Switch	RCV – Receive
BCS – Berthing Camera System	ROEU – Remotely Operated Electrical Umbilical
C&DH – Command and Data Handling	RPC – Remote Power Controller
DDCU - Direct Current-to-Direct Current Converter Unit	RPCM – Remote Power Control Module
DFMR – Design for Minimum Risk	SPDA – Secondary Power Distribution Assembly
EMU – Extravehicular Mobility Unit	SRMS – Shuttle Remote Manipulator System
EVA – Extravehicular Activity	SSRMS – Space Station Remote Manipulator System
HRDL – High Rate Data Link	SVM – Safety Verification Method
IVA – Interavehicular Activity	UMA – Umbilical Mating Assembly
MSWG – Mechanical Systems Working Group	UPS – Uninterruptible Power Supply
PAS – Payload Attach System, Payload Attach Site	VDC – Volts direct current
PRLA – Payload Retention Latch Assembly	XMT – Transmit

Connector	TYPE	Voltage	Max Current	Inhibit #1	Inhibit #2	Connector Type/Feature	EVA Automated
HIGH POWER CONNECTORS							
EVA Connector Power	AMS-02	120V DC (ISS)	~19 A	ISS RPC SPDA S3-1A4B, II 4B-E (A9), SPDA S3-3A, II03A-E(A2)	Demate UMA (Optional use of DDCU P1-3A and DDCU S1-4B)	NZGL06G2525LN7SN	EVA
ROEU	GFE	120V DC (APCU)	~19 A	APCU OFF	APCU Power Source Off	GFE Provided	Auto/ EVA Capable
ROEU	GFE	28V DC	~ 5A	Disable SSP2A Switches S16 Primary, S18 Secondary	Disable SSP 2ACircuit breaker CB4.	GFE Provided	Auto/ EVA Capable
UMA	GFE	120V DC (ISS)	~19 A	ISS RPC SPDA S3-1A4B, II 4B-E (A9), SPDA S3-3A, II03A-E(A2)	*Vehicle Discretion*	GFE Provided	Auto/ EVA Capable
PVGF	GFE	120V DC (ISS)	~15 A	(depends on location on ISS)	*Vehicle Discretion*	GFE Provided	Auto/ EVA Capable
LOW POWER CONNECTORS							
EVA Connector Data – 1553 Talkback	AMS-02	14V PtP (1553) <=5 V DC	Very Small – Signal <<1 A	ISS RPC SPDA S3-1A4B, II 4B-E (A9), SPDA S3-3A, II03A-E(A2)		NZGL06G1515N35PA-1	EVA
EVA Connector Fiber Optic/Talk Back	AMS-02	<=5 V DC	<<1 A	ISS RPC SPDA S3-1A4B, II 4B-E (A9), SPDA S3-3A, II03A-E(A2)		NZGL06G1717N13PN	EVA

Highlighted elements are GFE hardware and controlled by the supporting vehicle programs.

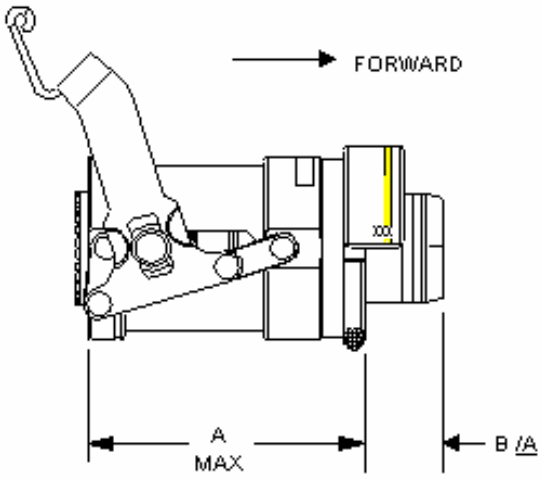


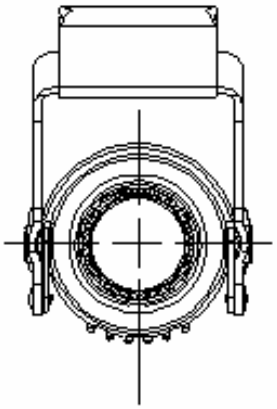
CABLE CONNECTORS

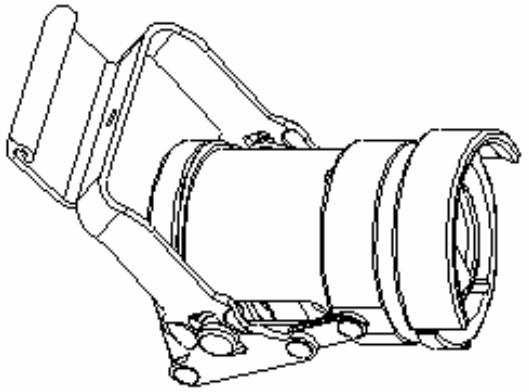
1553 – QTY: 1 EA P/N: NZGL06G1515N35PA-1
Fiber Optic – QTY: 1 EA P/N: NZGL06G1717N13PN
Power – QTY: 2 EA P/N: NZGL06G2525LN7SN
(Matching panel mounted connector halves Qty 2 for each)

From NASA Spec SSQ21635:

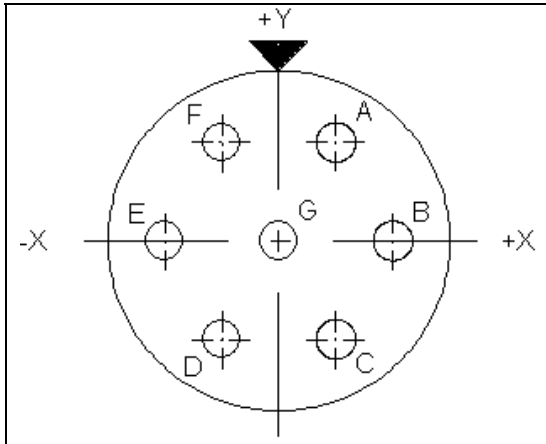
NZGL – NASA Zero-G Level Actuated
06 – Plug, Lever Actuated
G – Aluminum Shell, EMI Shielded, Environment Resisting
15, 17, 25 – Housing Size
15, 17, 25 – Insert Size
L – Size 25 Long Housing, (blank) – All other sizes
N – Electroless Nickel Finish
35, 13, 7 – Insert Arrangement
P – Pin, S- Socket
A, N – Polarization

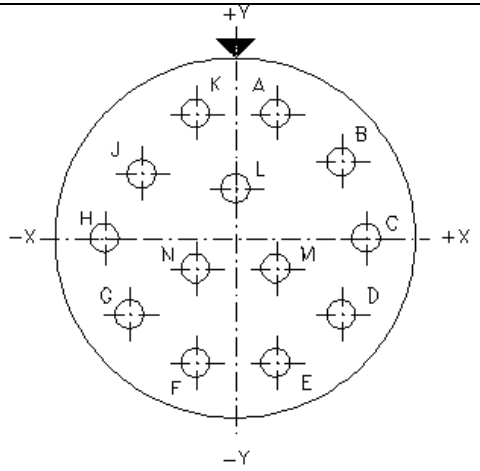






AMS-02 EVA Operable Connector





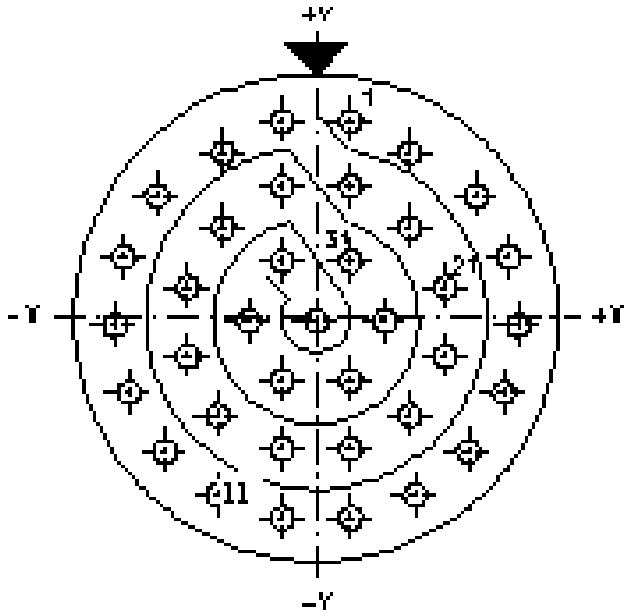
AMS-02 EVA CONNECTORS

Power Connector Pinout (Socket Side View)
(8 gauge pins/sockets)

Pin/Socket	Assignment
A	Power 120 VDC (+)
C	Power Return
D	Ground

Fiber Optics Connector Pinout (Socket Side View)
(16 gauge pin/sockets)

Pin/Socket	Assignment
A	5.0 VDC Power
B	5.0 VDC Power
C	HRDL XMT TO APS
D	5.0 VDC Power Return
E	5.0 VDC Power Return
F	5.0 VDC Power Return
G	5.0 VDC Power Return
H	HRDL RCV FROM APS
K	5.0 VDC Power
J	5.0 VDC Power



Mil-Std-1553 Bus Connector (Socket Side View)
(22 gauge pin/sockets)

Pin/Socket	Assignment
1	1553 Bus A Hi
2	1553 Bus A Lo
3	AMS Address Bit 0
4	AMS Address Bit 0 Return
5	AMS Address Bit 1
6	AMS Address Bit 1 Return
7	AMS Address Bit 2
8	AMS Address Bit 2 Return
9	AMS Address Bit 3
10	AMS Address Bit 3 Return
11	AMS Address Bit 4
12	AMS Address Bit 4 Return
13	AMS Address Parity Bit
14	AMS Address Parity Bit Return
15	1553 Bus B Hi
16	1553 Bus B Lo
17 – 20	Unused
21	5 VDC Loop Back (22)
22	5 VDC Loop Back (21)
23	5 VDC Loop Back (24)
24	5 VDC Loop Back (23)
25	5 VDC Loop Back (26)
26	5 VDC Loop Back (25)
27	5 VDC Loop Back (28)
28	5 VDC Loop Back (27)
29 – 37	Unused